REMARKS/ARGUMENTS

Applicants request that an amendment be entered to replace the specification with a substitute specification, as enclosed, in compliance with 37 C.F.R. §§1.121(b)(3) and 1.125(b). Applicants enclose a Petition under 37 C.F.R. § 1.182 to accept amendment by a substitute specification pursuant to 37 C.F.R. § 1.121(b)(3). The substitute specification is a correct English translation of the Japanese International Application PCT/JP00/03911 filed under 35 U.S.C. § 371 in the national phase filing in the U.S. Patent and Trademark Office for the above-identified application. The substitute specification includes no new matter.

Applicants request that an amendment of the claims be entered to add new claims 13 to 24 and cancel claims 1 to 12. The claims as amended include no new matter. Enclosed with this Petition and Amendment are a substitute specification, a clean version and a marked up version, in compliance with 37 C.F.R. §§ 1.121(b)(3) and 1.125(b); a Verification of Translation signed by Naoyuki Horibe of Aiwa International Patent Agency; a Declaration by Naoyuki Horibe of Aiwa International Patent Agency; and a Declaration by Valerie Chicchi of Woodcock Washburn LLP.

The substitute specification is filed to correct an error that inadvertently occurred. As stated in the Declaration by Naoyuki Horibe, Mr. Horibe inadvertently provided an incorrect English translation of the Japanese International Application PCT/JP00/03911. As stated in the Declaration of Valerie Chicchi, Ms. Chicchi inadvertently filed the incorrect English translation under 35 U.S.C. § 371 in the national phase filing in the U.S. Patent and Trademark Office on May 29, 2001. The incorrect English translation is from an unrelated case filed by Applicants at about the same time as the instant case.

Applicants replace the specification (pages 1 through 30) as filed in the U.S. Patent and Trademark Office on May 29, 2001 with the substitute specification (pages 1 through 16) enclosed with this Amendment and Petition, and as previously-filed by Applicants in the amendment on February 19, 2003. The substitute specification includes no new matter, since it is a correct English translation of the Japanese International Application PCT/JP00/03911.

The drawings, Figures 1 through 8, as originally filed with the U.S. Patent and Trademark Office on May 29, 2001 are correct. No amendment or substitution is made for Figures 1 through 8. Applicants request that the Examiner acknowledge receipt of the drawings as formal.

As in the previously-filed amendment on February 19, 2003, Applicants request entry of an amendment to add new claims 13 to 24 and to cancel claims 1-12. Support for new claims 13 to 24 can be found throughout the substitute specification submitted with this amendment and, for example, in paragraphs 14 through 29 on pages 3 to 6 of the substitute specification, and on pages 14 to 16 of the substitute specification. No new matter has been added by amendment to the claims.

A copy of the substitute specification under 37 C.F.R. §1.121(b)(3) filed with the U.S. Patent and Trademark Office by amendment on February 19, 2003 is attached herewith. Included with the substitute specification is a Verification of Translation stating that the attached English translation is a true and correct translation of U.S. Application No. 09/763,014 based on International Application PCT/JP00/03911, filed on June 15, 2000. Also included is a Declaration by Naoyuki Horibe of Aiwa International Patent Agency, stating that an error occurred in the translation as originally filed, and that the error was inadvertent. Also included is a Declaration by Valerie Chicchi of Woodcock Washburn LLP stating that an error occurred in filing the incorrect English translation under 35 U.S.C. § 371 in the national phase filing in the U.S. Patent and Trademark Office on May 29, 2001, and the that the error was inadvertent.

The request for entry of the amendment was objected to by the Examiner under 35 U.S.C. § 132 in Paper No. 11 dated May 16, 2003. Upon granting the Petition under 37 C.F.R. § 1.182, entry of the amendment is requested to correct the translation into English of the Japanese priority application and to enter claims corresponding to the correct English translation.

Date: September 16, 2003

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

SPECIFICATION

CARD-TYPE MAGNETIC RECORDING DEVICE

TECHNICAL FIELD

~~This invention relates to a card-type magnetic recording device, which is mounted to a portable computer for input or output of information to or from the computer.~~

~~BACKGROUND ART~~

~~Insertion of a card-type magnetic recording device in the shape of a PC card into a slot of a portable computer for supply of information from the magnetic recording device to the computer or vice versa permits the computer to increase a processing data capacity and also to provide additional functions.~~

~~In such a card-type magnetic recording device, a case body is generally composed of a frame, a frame plate formed together with the frame in one united body and upper and lower covers for covering the upside and the underside of the frame plate.~~

~~In addition to the frame plate, a circuit substrate mounted with elements on one surface is housed in the case body in the state of overlap with the frame plate. A space for housing a cartridge formed by housing a disk-shaped recording medium (which will be hereinafter referred to as a disk) in a shell is formed in the case body.~~

~~Further, various components such as a recording/reproducing head body for reading and writing information from and to the disk, a drive device for swinging a head arm of the recording/reproducing head body, a drive device (a motor) for revolving the disk, a lock means for holding the disk in the case and an ejector mechanism for ejecting the disk toward the outside of the case are mounted on one surface (the surface on the side of the circuit substrate) of the frame plate.~~

~~Most card-type recording devices in general use have dimensions based on PCMCIA standard Type II. According to this standard, dimensions of the case body of the card-type recording device are regulated to be 54.0 mm in width, 85.0 mm in length and 5.0 mm in thickness.~~

~~Thus, a considerable contrivance is required for housing the frame plate mounted with various components for recording/reproduction and revolution of the disk on one surface, together with the circuit substrate or the like mounted with the elements on one surface, in the case body having such a narrow space (a small thickness in particular), while securing a cartridge housing space in the case body.~~

~~Further, when the head is not in a disk access position, in other words, the head is placed in a standby position without reading or writing information from or to the disk, the head (and the head arm which carries the head) is placed distant from the disk in the radial direction of the disk, and moreover, the head is placed in a location further above the upside of the disk than it is placed in a location for readout of information from the upper side of the disk, and/or further below the underside of the disk than it is placed in a location for readout of information from the underside of the disk.~~

~~Thus, it is particularly necessary to take measures to prevent the (upper) head and the head arm from interfering with the other member (an upper cover, for instance) located above the upper head and the head arm, and/or preventing the (lower) head and the head arm from interfering with the other member (the frame plate, particularly) located below the lower head and the head arm, when the head and the head arm are in the standby position within the thin case body.~~

~~Further, the head for readout and writing of information from and to the disk is housed in a narrow space in the case body in close proximity to other components, and is therefore easily affected by electromagnetic noise originating from the elements mounted on the circuit substrate or a magnetic field generated from a stator coil as one of constituents of a disk drive motor, resulting in head reading/writing malfunctions.~~

~~DISCLOSURE OF THE INVENTION~~

~~It is an object of the present invention to secure a space, which is sufficient to permit a magnetic recording/reproducing head mounted on a head arm to be moved between a recording/reproducing position to obtain access of the head to a disk-shaped recording medium loaded in the device and a standby position to place the head in a location distant from the disk-shaped recording medium without interference of the head with other members arranged in the device, in a card-type magnetic recording device having dimensions regulated to meet the standard. Another object is to provide a means of preventing the magnetic recording/reproducing head from being affected by electromagnetic noise and a magnetic field originating from other components or elements close to each other in a limited space.~~

~~To attain the above objects, a card-type magnetic recording device according to the present invention comprises a disk housing space for housing a disk-shaped recording medium; a head arm carrying a magnetic recording/reproducing head and causing the magnetic recording/reproducing head to move between a recording/reproducing position to obtain access to the disk-shaped recording medium loaded in the disk housing space and a standby position at a distance from the disk-shaped recording medium; a frame plate which mounts the head arm and a disk drive device for driving the disk-shaped recording medium loaded in the disk housing space, on one surface thereof; and a circuit substrate, located on the other surface of the frame plate in overlap arrangement, having a plurality of elements arranged on the surface opposite to the surface facing the frame plate; wherein the frame plate has an opening or a concave part allowing the magnetic recording/reproducing head placed in the standby position and/or a part of the head arm to be housed therein. Thus, the magnetic recording/reproducing head can be moved between the standby position and the recording/reproducing position without interfering with the frame plate.~~

~~The opening formed in the frame plate having a thickness of 0.4mm permits the magnetic recording/reproducing head placed in the standby position to be lowered further by about 0.4 mm. On the other hand, while the concave part may be formed in~~

~~the frame plate by reducing the thickness of a part of the frame plate, the permissible length to lower the magnetic recording/reproducing head is limited in this case. However, the concave part formed by projecting the frame plate by means of drawing or the like increases the permissible length to lower the magnetic recording/reproducing head more than that in the above case.~~

~~According to one mode of the card type magnetic recording device according to the present invention, the head arm is composed of an upper arm which carries the magnetic recording/ reproducing head to gain access to the upside of a disk shaped recording medium and a lower arm carrying the recording/reproducing head to gain access to the underside of the disk shaped recording medium. Then, a part of the lower head arm and/or the head mounted on the arm may be housed in the opening or the concave part formed in the frame plate, and the distance between the magnetic recording/reproducing head mounted on the upper arm and the magnetic recording/reproducing head mounted on the lower arm in this state is made wider than the distance between the above magnetic recording/reproducing heads placed in the recording/reproducing position.~~

~~An electromagnetic shield material such as copper foil is adhered to the surface opposite to the circuit substrate in the frame plate using an adhesive so as to cover the opening. In this case, the copper foil has a thickness of about 40 μm, and the adhesive has a thickness of about 30 μm.~~

~~Instead of forming the opening, a concave part may be formed by reducing the thickness of a part of the frame plate. The portion having a reduced thickness is also used for the electromagnetic shield material.~~

~~Any digital IC is not arranged in a magnetic recording/reproducing head operation area and its neighborhood area on the circuit substrate, but an analog IC can be arranged in the above areas. Thus, noise originating from the digital IC can be prevented from having an effect on the magnetic recording/reproducing head. The magnetic recording/reproducing head is hardly affected by the analog IC. Further, the disk drive~~

device is a motor, and a stator of the motor is composed of a plurality of winding parts formed by winding a plurality of cores with coils. However, a core placed in a location corresponding to the magnetic recording/reproducing head operation area is exposed to the outside without being wound with a coil. Thus, the magnetic recording/reproducing head can be prevented from being affected by magnetic noise originating from the winding parts.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an exploded view showing a card-type magnetic recording device in the first embodiment according to the present invention;

Fig. 2 is a plan view showing the inside of the card-type magnetic recording device of Fig. 1 with an upper cover removed;

Fig. 3 is a plan view showing a frame plate in the card-type magnetic recording device of Fig. 1 as seen from the outside, together with a frame mounted on the frame plate in one united body;

Fig. 4A is a perspective view showing the frame plate of Fig. 3 as seen from the inside;

Fig. 4B is a perspective view showing the frame plate of Fig. 4A as seen from the outside;

Fig. 5 is a perspective view (partly in section) for illustrating a structure in which the frame plate of the card type magnetic recording device of Fig. 1 has an opening in a location facing a head standby position and this opening is covered with an electromagnetic shield;

Fig. 6 is a sectional view corresponding to the perspective view of Fig. 5;

Fig. 7 is a plan view showing a card-type magnetic recording device in the second embodiment according to the present invention having various IC elements arranged on the element mounting surface of a circuit substrate;

Fig. 8 is a view showing IC elements arrangement as a comparative embodiment for illustrating effects based on the arrangement of IC elements on the circuit substrate of Fig. 7; and

Fig. 9 is a plan view showing the inside of a card-type magnetic recording device in the third embodiment according to the present invention with an upper cover removed.

BEST MODE OF EMBODYING THE INVENTION

A description will now be given of the outline of a card-type magnetic recording device 1 according to the present invention with reference to Figs. 1 to 4A.

An upper cover 4 and a lower cover 5 are provided as a molded product obtained by pressing a thin SUS plate and are mounted on a frame 2 in one united body by engaging the opposite sides of the covers 4 and 5 to the frame 2 from outside, providing a case body of the card-type magnetic recording device 1. The size of the case body, that is, dimensions (width x length x thickness) of the card-type magnetic recording device 1 are based on PCMCIA standard type II to be 54.0 mm in width, 85.60 mm in length and 5.0 mm or less in width. Further, each of lower stage parts 4a, 5a at the left and right sides of the upper and lower covers 4, 5 has a width of not less than 3.0 mm, and a distance between the lower stage part 4a of the upper cover 4 and the lower stage part 5a of the lower covers 5 is set to be 3.30 mm.

Further, a frame plate 3 is provided as a molded product obtained by pressing a stainless steel plate (SUS plate) and are outsert-molded together with the synthetic resin frame 2 in one united body, providing the structural and strength foundations of the card-type magnetic recording device 1.

An insulating sheet 10 and a circuit substrate 11 are housed in the case body, in addition to the frame plate 3.

Various components such as a main ejector mechanism 6, a sub ejector mechanism 9, a magnetic recording/reproducing head body 7 and a disk drive motor 8 are mounted on the upside of the frame plate 3.

A cartridge 12 having a magnetic recording disk 13 housed therein is inserted into the card-type magnetic recording device 1. Further, the cartridge 12 inserted into the

~~card-type magnetic recording device 1 is ejected to the outside of the device through the operation of the main ejector mechanism 6 and the sub ejector mechanism 9.~~

~~The lower cover 5 as one of the constituents of the case body has a shutter 14. The shutter 14 is urged by the action of a spring to be held in a rising state at all times. On the other hand, the shutter 14 falls down through forward pivotal motions about the lower end when pressed by the end of the cartridge 12. A description will now be given of the frame plate 3 with reference to Fig. 3 showing the underside of the frame plate and Fig. 4A showing the upside thereof.~~

~~A cut-out hole 15 is formed at one side (the left side in Fig. 3) of a front part of the frame plate 3, and a mounting hole 15 is formed at the other side (the right side in Fig. 3) thereof. The cut-out hole 15 is used for holding a FPC 61 (see Fig. 2). An upper yoke 17a, a lower yoke 17b and a stator magnet 18 as constituents of the magnetic recording/reproducing head body 7 (see Fig. 1) are mounted in the mounting hole 16.~~

~~Further, a concave part 20 for mounting a pivotal axis 21 (see Fig. 2) of the magnetic recording/reproducing head body 7 is formed in the front part of the frame plate 3 at an approximately intermediate position between the cut-out hole 15 and the mounting hole 16.~~

~~On the other hand, a concave part 19 having a circular cross-sectional shape for mounting the disk drive motor 8 is formed in a rear part of the frame plate 3 by means of drawing, as shown in Fig. 4A. A hole 39 for mounting a bearing (not shown) of the disk drive motor 8 is formed in the center of the bottom surface of the concave part 19. Then, a plurality of (18 pieces in Figs. 3 and 4A) coil mounting slots 38 extending from the center of the center hole 39 in a radial direction are formed in the bottom surface of the concave part 19.~~

~~The disk drive motor 8 is composed of a stator 45 and a rotor 44. The stator 45 has radially extending magnetic cores (not shown) as many as (eighteen pieces) the coil mounting slots 38 in locations around the axis of rotation of the rotor 44. The~~

~~eighteen pieces of coil winding parts 45d are formed by winding each of the eighteen pieces of cores with coil wires a predetermined number of turns. These coil winding parts 45d are placed in locations corresponding to the eighteen pieces of coil mounting slots 38 formed in the bottom surface of the concave part 19.~~

~~Further, as shown in Fig. 4A, open holes 36 as many as the coil mounting slots 38 are formed in a peripheral wall 35 of the concave part 19 in locations corresponding to the middles of the adjacent slots 38 in the bottom surface of the concave part 19. These open holes 36 are for relief of stress resulting from a process of drawing, and it is necessary to form the open holes in a material of a flat frame plate 3 before being subjected to drawing. Incidentally, each open hole 36 may extend from the peripheral wall 35 of the motor mounting concave part 19 to the bottom surface of the concave part 19 (to the middle between the adjacent slots 38).~~

~~On the other hand, the rotor 44 has a ring shaped permanent magnet 46, which attracts a hub of the magnetic recording disk 13 housed in the cartridge 12.~~

~~Further, various projecting parts functioning as axes and anchor parts of other components mounted on the frame plate 3 are formed on the upside of the frame plate 3.~~

~~A description will now be given of the main ejector mechanism 6 and the sub ejector mechanism 9 mounted on the upside of the frame plate 3 with reference to Figs. 1 and 2. When the cartridge 12 is inserted into the card type magnetic recording device 1, the main ejector mechanism 6 locks the inserted cartridge 12 in the card type magnetic recording device 1. On the other hand, when the cartridge 12 is again pushed forward a little, the main ejector mechanism 6 releases the cartridge 12 from its locked state to eject the cartridge 12 to the rear.~~

~~The main ejector mechanism 6 comprises a cam plate 22, a slider 23, an ejector spring 24 and an engagement gear 25. The cam plate 22 is supported on the frame plate 3 in a manner such that it can turn about an axis and is urged at all times so that it swings clockwise as shown in Fig. 2. Further, a grooved cam 26 is formed on one~~

surface of the cam plate 22, and a gear is formed at the peripheral edge of the cam plate 22. A pin 28 at the front end of the slider 23 is engaged with the grooved cam 26.

When the cartridge 12 is pushed in the card-type magnetic recording device 1 through the opening at the rear, the slider 23 is pressed forward, the main ejector mechanism 6 is locked, and the shutter 14 of the cartridge 12 is then opened to thereby permit the magnetic recording disk 13 to be loaded in the card-type magnetic recording device 1.

The gear 27 of the cam plate 22 meshes with the engagement gear 25 supported on the frame plate 3 in a manner such that it can rotate about an axis. The engagement gear 25 also has a projecting portion 29, in addition to a gear part. The slider 23 is arranged on the inside of one side (the left side in Fig. 2) of the frame 2 slidably, as shown in Fig. 2.

The sub ejector mechanism 9 has a lever 47 mounted on the frame plate 3 so that it can swing about an axis, a first return spring 48 for urging the lever to the rear (toward the ejecting direction of the cartridge) and a second return spring (not shown) subjected to accumulation of energy when the lever 47 is moved forward, as shown in Fig. 2. The sub ejector mechanism 9 permits the lever 47 urged by the first return spring 48 and the second return spring to push out the cartridge 2 to the rear in cooperation with the main ejector mechanism 6 when the cartridge 12 is released from its locked state. A description will now be given of the magnetic recording/reproducing head body 7 mounted on the upside of the frame plate 3 with reference to Figs. 1 and 2.

The magnetic recording/reproducing head body 7 comprises a resin base body part 31, a head arm 32, a drive coil 33 and a magnetic recording/reproducing head (which will be hereinafter referred to as a head) 34 mounted on the end of the head arm 32.

The drive coil 33 and the head arm 32 are respectively fixed to the opposite sides of the base body part 31 in one united body. The magnetic recording/reproducing head body 7 is mounted on the frame plate 3 as being freely pivoted about a pivotal axis 21 arranged in the center of the base body part 31 (that is, a position of center of gravity of

the whole magnetic recording/reproducing head body 7). A power lead wire (not shown) connected to the drive coil 33 and a signal lead wire (not shown) connected to the head 34 are connected to the base body part 31.

The head arm 32 swings about the pivotal axis 21 so that the head 34 moves between a first position A (a standby position shown by a solid line in Fig. 2) where the head 34 is isolated from the magnetic recording disk (hereinafter referred to as disk) 13 in the radial direction as well as in the direction of disk rotation axis and a second position B (a recording/reproducing position shown by a broken line in Fig. 2) where the head comes closer to the surface of the disk 13 in consequence of movement from the first position A in the radial direction of the disk 13 as well as in the direction of the disk rotation axis. An angle between the first position A and the second position B is about 30 degrees. Further, the head arm 32 slides in the radial direction of the magnetic recording disk 13 to gain access to the magnetic recording disk 13 in the second position B (the recording/reproducing position).

A description will now be given of the circuit substrate 11.

The circuit substrate 11 has a power circuit, an information processing circuit, and electric elements such as a switching circuit, an amplifying circuit, a CPU and a memory (see Fig. 5) required for the above power circuit and the information circuit on the base formed mainly by a resin. The circuit substrate 11 is arranged on the underside of the frame plate 3 through the insulating sheet 10. The insulating sheet 10 is adapted to eliminate troubles of direct contact of various projection parts existing on the upside of the circuit substrate 11 with the frame plate 3.

The electronic element 41 is arranged on the (underside) surface of the circuit substrate 11 opposite to the insulating sheet 10. An external connection connector 51 meeting PCMCIA standard is mounted on the circuit substrate 11 along the front edge of the circuit substrate 11.

Power is supplied to the disk drive motor 8 fixed to the motor concave part 19 of the frame plate 3 through a connector (not shown) provided on the underside of the circuit

substrate 11. A signal from the magnetic recording/reproducing head body 7 of which pivotal axis 21 is fitted to the axis mounting concave part 20 of the frame plate 3 is given to a connector (not shown) provided on the underside of the circuit substrate 11 through a signal line. Further, power is supplied from a connector (not shown) provided on the underside of the circuit substrate 11 to the magnetic recording/reproducing head body 7 through a power line. The signal line and the power line for connection between the circuit substrate 11 and the magnetic recording/reproducing head body 7 are put together in the FPC 61. A notch part 50 to allow the FPC 61 to pass is formed at one side end of the circuit substrate.

A description will now be given of the first embodiment of the present invention in more detail with reference to Figs. 4B to 6.

In the first embodiment, the head arm 32 is composed of an upper arm 32a gaining access to the upside of the magnetic recording disk 13 and a lower arm 32b gaining access to the underside of the magnetic recording disk 13. Thus, the heads 34 are mounted on the upper arm 32a at the end thereof and also on the lower arm 32b at the end thereof, respectively, as shown by reference numerals 34a, 34b.

Figs. 5 and 6 show the state where the upper arm 32a and the lower arm 32b as constituents of the head arm 32 together with the heads 34a, 34b mounted to the ends of the arms 32a, 32b are in a standby position (corresponding to the position A in Fig. 2). These arms and heads in the recording/reproducing position (corresponding to the position B in Fig. 2) are shown in Figs. 5 and 6 by putting " ' " on the corresponding reference numerals for indicating that they are positioned in a recording/reproduction position. That is, in Figs. 5 and 6, the arm 32' (the upper arm 32a' and the lower arm 32b') and the heads 34a' and 34b' mounted on the ends of the arms 32a', 32b' indicate that they these arms and heads are positioned in the recording/reproducing position.

As is apparent from Figs. 5 and 6, the distance between the upper arm 32a and the lower arm 32b on standby (or between the heads 34a and 34b on standby) is made

~~wider (in an open state) than the distance between the upper arm 32a' and the lower arm 32b' in process of recording/reproduction (or between the heads 34a', 34b' on standby). This is because considerations are made to move the head arm 32 on standby to the recording/reproducing position by taking the actions of lowering the upper arm 32a from a position above the magnetic recording disk 13 toward the upside of the magnetic recording disk 13, while raising the lower arm 32b from a position below the magnetic recording disk 13 toward the underside of the magnetic recording disk 13.~~

~~An opening 37 (see Fig. 4A) for housing the lower arm 32b and the head 34b mounted on the end of the lower arm 32b is formed in the frame plate 3 such that the upper and lower arms 32a, 32b placed in the open state in the standby position can be housed in the card type magnetic recording device 1 having the dimensions regulated to meet PCMCIA Type II standard.~~

~~As a result, when the head arm 32 is in the standby position, the end of the lower arm 32b is housed in the opening 37 formed in the frame plate 3 without being placed on the frame plate 3, as shown in Fig. 6. In consequence, the head arm 32 can hold its open state in the card type magnetic recording device 1 having a thickness regulated to meet the above standard.~~

~~In movement of the head 34 placed in the standby position to the recording/reproducing position, the upper arm 32a and the lower arm 32b as constituents of the head arm 32 moves to the positions (the recording/reproducing positions) shown by reference numerals 32a', 32b' in Figs. 5 and 6, while being guided by a guide mechanism (not shown) in a direction of coming closer to the magnetic recording disk 13 as shown by dotted lines with arrows in Figs. 5 and 6.~~

~~While the opening 37 is formed in the frame plate 3 to eliminate the interference of the lower arm 32b of the head arm 32 with the frame plate 3 as shown in Figs. 5 and 6, a concave part may be formed, instead of the opening 37, if a reduction in thickness of a part of the frame plate 3 (that is, formation of the concave part) makes it possible to prevent the lower arm 32b from interfering with the frame~~

plate 3. As described above, either forming an opening in the frame plate 3 or a concave part by locally reducing the thickness of the frame plate can prevent the head arm 32 from interfering with the frame plate 3.

When the opening 37 is formed in the frame plate 3, the electromagnetic noise originating from the electronic element 41 mounted on the circuit substrate 11 arranged on the underside of the frame plate 3 through the insulating sheet 10 reaches the head 34 (34a, 34b) placed in the standby position through the opening 37 and as a result, has an effect on the head. To avoid the above situation, it is necessary to cover the opening 37 formed in the frame plate 3 with an electromagnetic shield material 40 adhered to the underside of the frame plate 3 with an adhesive, as shown in Fig. 4A. Since the opening 37 of the frame plate 3 is covered with the electromagnetic shield material 40, the electromagnetic noise originating from the electronic element 41 mounted on the circuit substrate 11 may be restrained from reaching the head 34 (34a, 34b) through the opening 37.

Incidentally, the electromagnetic shield material 40 may extend toward the concave part 19 for mounting the disk drive motor, formed in the frame plate 3, to cover one or more (two in the embodiment in Fig. 4B) open holes 36 near the head 34 (34a, 34b) among the eighteen pieces of open holes 36 formed in the peripheral wall of the concave part 19, as shown in Figs. 4B, 5 and 6. Also, the electromagnetic shield material 40 may extend therefrom to cover one or more (two in the embodiment in Fig. 4B) coil mounting slots 38 near the head 34 (34a, 34b) among the eighteen pieces of coil mounting slots 38.

Fig. 4B shows an embodiment wherein an electromagnetic shield material 40a for covering the open holes 36, the electromagnetic shield material 40 for covering the opening 37 and the electromagnetic shield material 40 for covering the coil mounting slots 38 are formed in one united body. Instead of this structure, the above electromagnetic shield materials 40 may be formed individually.

As has been described above, the card-type magnetic recording device 1 according to the first embodiment of the present invention makes it possible to prevent the head arm 32 and the head 34 placed in the standby position from interfering with the frame plate 3 within the card-type magnetic recording device having a limited thickness, by forming the opening 37 in the part of the frame plate 3 or forming the concave part instead of the opening 37.

Further, the opening 37 formed in the frame plate 3 is covered with the electromagnetic shield material 40 so that the influence of the electromagnetic noise, originating from the circuit substrate 11 and passing through the opening 37, on the head 34 can be reduced.

Further, the coil mounting slots 38 formed in the frame plate 3 for arrangement of the stator coil 45 and the open holes 36 formed in the frame plate 3 for relief of stress resulting from a process of drawing for formation of the motor mounting concave part 19 may be covered with the electromagnetic shield material 40a, so that the influence of the noise, originating from the circuit substrate and passing through the slots 38 and the open holes 36, on the head 34 can be reduced.

A description will now be given of the outline of a card-type magnetic recording device 1 in the second embodiment according to the present invention with reference to Figs. 7 and 8.

As shown in Fig. 7, a connector 70 connected to a connector terminal 62 (see Fig. 2) formed at the end of the FPC 61 is mounted on the circuit substrate 11 in the proximity of a notch part 50. Further, essential ICs such as a read circuit analog IC 81, a motor drive IC 82 for controlling drive of the disk drive motor and the drive motor of the magnetic recording/reproducing head body 7, a logic IC 83 for converting a mode of a signal to and from external information equipment (not shown), a logic IC 84 for supporting the deficient functions of the logic IC 83, a MPU and a logic IC 85 for controlling the whole motions of the magnetic recording disk 13 for recording,

reproduction and driving, a memory IC 86 for storing the basic software and a power supply IC 87 are mounted on the circuit substrate 11.

Among the above essential ICs, the read circuit analog IC 81 and the motor drive IC 82 are analog ICs, while the logic ICs 83, 84, the MPU and logic IC 85, the memory IC 86 and the power supply IC 87 are digital ICs,.

An imaginary line in Fig. 7 shows that the head 34, which is arranged above the circuit substrate 11, moves within an operation area between the first position A (corresponding to the position A in Fig. 2) and the second position B (corresponding to the position B in Fig. 2).

As shown in Fig. 7, it is a features of the second embodiment that considerations are made not to arrange any digital ICs in the operation area of the head 34 on the circuit substrate 11. This is because current supplied to the analog IC (ICs 81, 82) is several mV, whereas current supplied to the digital IC (ICs 83 to 87) is in the range of 0 to 5V, with the result that noise originates from the digital IC exclusively and has an effect on the head 34.

Thus, if the arrangement of the essential ICs (ICs 81 to 87) is made as shown in Fig. 8, the noise originating from the logic IC 84 provided as the digital IC arranged in the operation area of the head 34 has an effect on the head, resulting in occurrence of errors in recording and reproduction to and from the magnetic recording disk 13.

In Fig. 7, the read circuit analog IC 81 is arranged in the operation area of the head 34 on the circuit substrate 11. This is because the IC 81 is an IC which operates in response to a feeble signal, and therefore, is affected by the noise if the IC 81 is arranged distant from the connector 70 to make a wiring pattern longer. For that reason, the IC 81 needs to be arranged close to the connector to prevent the IC 81 from being affected by the noise as much as possible.

As has been described above, the card-type magnetic recording device 1 in the second embodiment according to the present invention makes it possible to prevent the noise originating from the digital ICs from having an effect on the head 34 by arranging

the digital ICs on the circuit substrate 11 outside the operation area of the head of the magnetic recording/reproducing head body. The analog ICs may be arranged in the operation area of the head 34 of the magnetic recording/reproducing head body on the circuit substrate 11. A description will now be given of the outline of a card-type magnetic recording device 1 in a third embodiment according to the present invention with reference to Fig. 9.

In the above card-type magnetic recording device 1 shown in Fig. 2, the head 34 may be affected by the magnetic noise originating from one winding part 45d located close to the head 34 placed in the position B (the recording/reproducing position) in Fig. 2 among eighteen pieces of winding parts 45d forming the stator of the disk drive motor, resulting in hindrance of normal writing and readout operations.

For avoiding the above problem, it is well-known to project a flange from a member which supports a stator of a motor for driving a magnetic recording disk so as to separate the stator from the magnetic disk (and the magnetic head) and then adhere a magnetic shield thin plate consisting of a material of high magnetic permeability to the stator-side surface of the flange, forming a closed magnetic circuit with the stator, a rotor magnet facing the stator, a rotor holder for holding the rotor magnet, the stator and the flange. (Refer to Japanese Utility Model Publication No. 2-2066) However, the well-known technique has a disadvantage in that the magnetic shield thin plate consisting of the material of high magnetic permeability is expensive, and much labor is required for adhering the magnetic thin plate to a predetermined position of the flange.

According to the third embodiment, the problems with the above prior art are dissolved by providing a non-winding part C formed by winding no coil around one core 45e located close to the head 34 placed in the recording/reproducing position (the position B of Fig. 9) to expose the core 45e to the outside.

In Fig. 9, the head arm 32 makes swing motions about the pivotal axis 21 between the standby position (the position A shown by a solid line in Fig. 9) where the

~~head 34 mounted on the end of the head arm takes retreat from the disk area and the recording/reproducing position (the position B shown by a broken line in Fig. 9) where the head 34 comes closer to the surface of the magnetic recording disk 13 for recording and reproduction, similarly to the head arm shown in Fig. 2.~~

~~Even if one of eighteen pieces of winding parts 45d forming the stator 45 of the disk drive motor 8 is made non-winding part C, driving of the disk drive motor 8 is hardly influenced.~~

~~According to the third embodiment, since the head may be protected from the influence of the magnetic noise originating from the winding parts 45d only by winding no coil around one of a plurality of cores, it is possible to provide a magnetic recording device which is available at a low cost and has a higher reliability in comparison with the prior art described above.~~

[0001] This invention relates to a card-type magnetic recording device, which is mounted to information equipment such as a personal computer for readout or input of information from or to the information equipment.

BACKGROUND ART

[0002] Insertion of a card-type magnetic recording device such as a PC card into a slot of a personal computer for readout or input of information from or to the magnetic recording device permits the personal computer to provide additional functions and also to increase a processing data capacity.

[0003] A shell of a cartridge formed by housing a disk-shaped recording medium (which will be hereinafter referred to as a disk) in the shell is inserted into the card-type magnetic recording device through an insertion opening detachably. A shutter of the shell is opened to expose a head to the outside through the operation of inserting the cartridge into the card-type magnetic recording device through the insertion opening. As a result, the head gains access to the exposed disk-recording surface for recording or reading of information to or from the disk.

[0004] The head makes movement between an access position for reading or writing of information from or to the disk in contact with or a slight distance from the disk after movement of the head onto the surface of the disk and a retreat position for support of the head with a load ramp on termination of reading or writing of information. Incidentally, when the opposite surfaces of the disk are available, the head gains access to the upper lower surfaces of the disk.

[0005] In case of HDD (hard disk drive), the head is mounted to the end of a head arm of swing arm structure permitting swing motions about an axial portion of a base part. On the other hand, in case of FDD(floppy disk drive), the head is mounted to a movable body actuated in a radial direction. In either case, the head is supported with the load ramp at the retreat position after being moved thereto, when there is no need for reading or writing of information from or to the disk.

[0006] A description will now be given of the positional relationship among the head, the disk and the load ramp. In HDD, since the disk is in a fixed location at all times and thus requires neither insertion into the magnetic recording device nor removal from the magnetic recording device, the load ramp is located on the surface of the disk in overhang arrangement (Refer to Figs. 4A to 4C of US Patent No. 4,933,785 (or its corresponding Japanese Toku-hyo No. 3-503101)) to permit no gap between the end of the load ramp and the periphery of the disk when the head is moved from the retreat position to the access position, or on the contrary, returned from the access position to the retreat position.

[0007] However, in FDD, since there is a need for insertion or removal of the disk into or from the magnetic recording device, it is difficult to locate the load ramp on the surface area (the head access position) of the disk in overhang arrangement. That is, a special means is required for preventing the peripheral edge of the disk inserted into the magnetic recording device through the insertion opening from coming into collision with the load ramp.

[0008] In this connection, there is proposed a technique related to a load ramp having a structure which is opened upward and downward to accept the disk in

advancement of the disk toward the load ramp and is then closed to guide the head smoothly to the surface area of the disk in movement of the head from the retreat position to the access position (Refer to U.S. Patent No. 5,995,332). However, since the opening/closing structure of the load ramp is complicated, there is a drawback to the use of this load ramp under the dimensionally limited environment (in respect of a thickness particularly) such as the PC card.

[0009] When a PC card based on PCMCIA standard Type II is in use, its dimensions (width X length X thickness) are regulated to be 54.0 mm in width, 85.60 mm in length and 5.0 mm in thickness, and a lower stage part is also regulated to have a thickness of 3.30 mm.

[0010] The above dimensions are considered to be values remarkably severe on a magnetic recording device, which has a movable part such as a head arm and a disk drive motor on the inside and also requires a mechanism for insertion and removal of the cartridge of the disk, while being allowed to ensure a structural strength.

[0011] Under the above conditions, each component is strictly limited as to the form (in respect of a thickness particularly) and the dimensional accuracy or positional relationship, otherwise a slight difference in dimension may affect greatly the other portions in some cases.

[0012] The same may be said of the head arm which carries a recording/reproducing head, and the head arm which carries designed as small as possible while maintaining its primary functions is required. Most head arms are of a type permitting pivotal motions about an axis of the base part and have a shock-absorbing flat spring material called a gimbal spring fixed at its end to fix the head to the flat spring material by bonding or the like. One end of the gimbal spring is engaged with an engagement hole formed a the end of the head arm, and the other end thereof is fixed to a portion at the rear of the end of the head arm, resulting in prevention of unnecessary vibrations. However, the dimensional limitations as described above makes it impossible to lengthen the end portion of the gimbal spring engaged with the engagement hole of the head arm at random. Thus, even though the head arm maintains stability normally in the

state of being supported with the load ramp at the retreat position, usually available somewhat great shocks cause elastic deformation of the gimbal spring as being pivoted in the thickness direction of the head arm, resulting in a possibility that the end of the gimbal spring may be disengaged from the engagement hole of the head arm.

[0013] While a synthetic resin molded product is often available for the load ramp, a large thickness is required for the load ramp in consideration of keeping of the form and installation strength, and a support part for guiding the arm is formed in a flat shape.

DISCLOSURE OF THE INVENTION

[0014] It is an object of the present invention to provide a card-type magnetic recording device, which makes it possible to mount a disk to the inside under the requirements of dimensions restricted within narrow limits, permits a head arm to be moved smoothly between a position for access of the head arm to the disk and a position for retreat of the head arm from the disk, and further has the head arm resistant to shocks.

[0015] To attain the above object, in a card-type magnetic recording device according to the present invention, a head arm, to which a head is mounted, is formed in a flat plate-like shape and adopts a swing arm structure permitting swing motions about an axis of a base part, while a load ramp is arranged at a distance from the peripheral edge of the disk.

[0016] The head arm meeting both the flat plate-like shape requirement and the swing arm structure requirement permits less vertical dimensions of the head arm, resulting in less thickness of the card-type magnetic recording device. Further, since the load ramp is arranged at a distance from the peripheral edge of the disk, the disk may be installed at its set position without hindrance.

[0017] There is provided a guide means for guiding smoothly the head making movement between the load ramp and the periphery of the disk. The guide means makes it possible to prevent the head arm from falling in a gap between the load ramp and the disk. It is required that the guide means should keep high the end of the head arm

moving through the above gap portion without being inclined largely. The guide means may be provided on the head arm or a frame plate axially supporting the head arm or between the head arm and the load ramp.

[0018] The card-type magnetic recording device comprises a head arm of swing arm structure, a motor, a load ramp and an information processor. The head arm carries a magnetic recording/reproducing head at its end. The motor revolves the disk serving as a recording medium for recording of information. The load ramp permits the head to stand ready for movement to the next access position after retreat of the head from the surface area of the disk with the end of the head arm supported, while permitting the head to be moved smoothly to the disk surface.

[0019] The head arm has a guide arm. The guide arm is provided to the guide arm on a position at a short distance from the end where a head is mounted toward intermediate portion in the longitudinal direction in a manner such that the guide arm projects toward the side opposite to the disk.

[0020] The head arm and the load ramp need a structure having the following relation. In a position of disengagement of the head arm end mounted with the head from the load ramp, the projecting end of the guide arm remains behind the load ramp, resulting in maintenance of the head arm end at an isolation position permitting no contact of the head with the disk until the guide arm is disengaged from the load ramp.

[0021] Incidentally, the head and the head arm are of normally available structure. The head arm is pivoted about a base end opposite to the end mounted with the head and also shows spring performance for urging the head toward the surface of the disk. Further, the head arm is normally arranged face to face with the opposite surfaces of the disk so as to gain access to the opposite surfaces of the disk. According to this configuration, while the projecting end of the guide arm remains behind the load ramp to maintain the head arm end a the isolation position permitting no contact of the head with the disk, the head at the end of the head arm may be moved to the surface area of the disk, resulting in a smooth movement of the head from the load ramp to the disk.

[0022] A taper-surface beginning position of support part may be located closer to the disk that a taper-surface beginning position of a rail part in some cases. According to this configuration, the support part permits the head to maintain higher in movement of the head from the retreat position to the access position, resulting in less possibility that the end of the head arm may fall in the gap between the load ramp and the peripheral edge of the disk. On the other hand, the guide arm makes contact with a taper surface of small inclination in movement of the head from the access position to the retreat position. Thus, the guide arm may easily ride onto such a taper surface for guiding the head smoothly toward the retreat position.

[0023] The load ramp is structured to have a support part for supporting the end of the head arm and a rail part for supporting the end of the guide arm, and the ends of the support part and the rail part on the side of a disk may have a taper surface inclined toward the disk, serving as a head arm guide part, respectively. According to this configuration, the end of the head arm is supported with the rail part even for the duration of movement, resulting in stable movement of the head arm.

[0024] The projecting end of the guide arm is located closer to the inner side of the head arm than the end of the head arm, while maintaining a difference in altitude with respect to the end of the head arm, and the same difference in altitude as the above difference is provided between the support part and the rail part in the load ramp correspondingly to the above difference. According to this configuration, since the guide arm may make contact with the rail part of the load ramp in a portion closer to the disk than the end of the head arm to move the head to the surface area of the disk in the state of being brought closer to the disk surface, upward and downward movements of the head after being brought closer to the disk are reduced, resulting in an increase of accuracy.

[0025] Further, the end of the head arm is often structured to make contact with the load ramp through a wiring gutter-shaped part located at the longitudinal opposite edges of the head arm. According to this structure, contact of the load ramp with the end

of the head arm is provided in the form of line contact, resulting in a reduction in resistance to the head arm when moved along the support part of the load ramp.

[0026] A card-type magnetic recording device comprises a recording/reproducing head, a head arm of swing arm structure permitting swing motions about an axis of a base part, a motor for driving a disk serving as a recording medium for recording of information, a load ramp and an information processor.

[0027] The head arm makes movement between an access position adapted to locate the head on the surface area of the disk and a retreat position adapted to locate the head at a fixed position out of the surface area of the disk. The head arm has a shock-absorbing flat spring material (a gimbal spring) at its end and carries the head with the flat spring material. The base side of the above flat spring material is fixed to the head arm, and the end thereof is engaged with an engagement hole formed at the end of the head arm.

[0028] The load ramp is fixed to the retreat position of the head arm and has a support part for supporting the end of the head arm. The contact portion of the head arm with the load ramp is equivalent to a portion where the shock-absorbing flat spring material is fixed to the support spring.

[0029] Then, the support part of the load ramp is structured such that its surface at the side of the head arm end is inclined toward the base part of the head arm, thus permitting the contact portion of the head arm end with the support part to be brought closer to the base part of the head arm. According to this structure, a distance from the head mounting position to the contact portion of the head arm supported with the load ramp is increased in the retreat position. That is, the radius in elastic deformation of the shock-absorbing flat spring material in the thickness direction when shocked is made larger than that in case of forming the support surface in the flat shape, thus permitting enhancement of shock-absorption performance. The increase in radius as described above also permits less horizontal displacement (a reduction in displacement in a base part direction) of the head arm end at a time when the end of the flat spring material is pivoted within the range of the engagement hole, resulting in prevention of the end of the

shock-absorbing flat spring material from being disengaged from the engagement hole at the head arm end when shocked.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030] Fig. 1 is an exploded view showing one preferred embodiment of a card-type magnetic recording device according to the present invention, together with a cartridge inserted into the magnetic recording device;

[0031] Fig. 2 is a view showing the inside of the card-type magnetic recording device of Fig. 1 with an upper cover removed;

[0032] Fig. 3 is a perspective view showing a head arm and a load ramp as components of the card-type magnetic recording device of Fig. 1;

[0033] Fig. 4 is a view showing the head arm of Fig. 3 as seen from its end side (from a direction indicated by an arrow A of Fig. 3);

[0034] Fig. 5 is a view showing the load ramp of Fig. 3 as seen from a direction indicated by an arrow B of Fig. 3, and this load ramp supports the head arm (the head is in a retreat position);

[0035] Fig. 6 is a view showing the state of the head arm further advanced from the position of Fig. 5 toward a disk;

[0036] Fig. 7 is a view showing the state of access of the head to the disk in consequence of further advancement of the head arm from the position of Fig. 6 toward the disk; and

[0037] Fig. 8 is a view showing the load ramp of Fig. 3 as seen from the end side of a support part of the load ramp (from a direction indicated by an arrow C of Fig. 3).

BEST MODE FOR EMBODYING THE INVENTION

[0038] Fig. 1 shows a card-type magnetic recording device 1 based on PCMCIA standard Type II, together with a disk 2.

[0039] A disc-type magnetic recording medium (which will be hereinafter referred to as a disk) 2 is housed in a shell 3 to provide a cartridge 4. The shell 3 has a shutter 5. The shutter 5 is energized in a closing direction at all times, while being opened through the operation of loading the cartridge 4 into the magnetic recording device 1 through its insertion opening 33 (the shutter in the opened state is shown in Fig. 1).

[0040] The magnetic recording device 1 comprises a body 6, an upper cover 7, a lower cover 8 and an information processor 9. An insulating sheet 10 is disposed between the body 6 and the information processor 9.

[0041] Both the upper cover 7 and the lower cover 8 are formed by pressing a stainless-steel thin plate and are mounted to the upper and lower surfaces of the body 6 by engagement and bonding.

[0042] The body 6 is composed of a synthetic resin peripheral frame 11, a frame plate 12 outsert-molded together with the peripheral frame in one united body and various components mounted on the frame plate 12 such as a spindle motor 13, a head arm 14, a load ramp 15 and an ejector mechanism 16. The spindle motor 13 is to drive the disk 2.

[0043] The information processor 9 is configured by incorporating various elements and packages into a circuit substrate and has an input/output part for readout or writing of information from or to the disk 2, as well as processing of information and control of driving of the motor 13 and the head arm 14. The magnetic recording device 1 is connected to the information processor 9 through a connector 32.

[0044] A description will now be given of the structure of the head arm 14 with reference to Figs. 3 and 8.

[0045] A base body 19 of the head arm 14 is provided as a hard resin molded product, which is mounted to the frame plate 12 so that it can rotate about an axis 23. The head arm 14 is composed of an upper arm 17 and a lower arm 18, which are fixed to the base body 19 in face-to-face arrangement. Thus, the upper and lower arms 17 and 18

are pivoted simultaneously about the axis 23 of the base body 19 for readout or writing of information from or to the opposite surfaces of the disk 2.

[0046] The base body 19 further has a drive coil 24. The drive coil 24 is adapted to drive the head for movement to an access position, and movement of the head from the access position to the retreat position is made by utilizing elasticity of a return spring (not shown). A spring of the ejector mechanism is also used for the return spring.

[0047] The upper arm 17 and the lower arm 18 are the same structure. As shown in Fig. 8, each of the arms 17 and 18 is composed of a body spring 20, a support spring 21 and a gimbal part 22.

[0048] The body spring 20 is formed by pressing a stainless steel thin plate into a substantially flat elongate plate having an elastic bending part 31 (see fig. 3) at its intermediate portion, and the rear end of the body spring is fixed to the base body 19.

[0049] The support spring 21 is mounted to a front portion of the body spring 20 so as to permit lift-up of its longitudinal end side. Further, the end of the support spring 21 is punched with a press to provide the gimbal part 22. The gimbal part 22 has a projecting end inserted into an engagement hole 25 formed at the end of the body spring 20.

[0050] A magnetic recording/reproducing head (which will be hereinafter referred to as a head) 26 is bonded to an intermediate portion of the gimbal part 22.

[0051] As shown in Fig. 3, the body spring 20 has a guide arm 27 projecting (toward the location of the load ramp which will be explained later) from the side edge on the side opposite to the disk at a position substantially intermediate in the longitudinal direction (a position at a short distance from the head 26 mounting position toward the base body 19).

[0052] The projection length of the guide arm 27 is about half of the width of the body spring 20 in the vicinity of the base of the guide arm 27.

[0053] As shown in Fig. 3, the body spring 20 has a gutter-shaped part 28 bent in the shape of letter U in section at the left and right side edges of a portion extending from the end to the elastic bending part 31 (which will be described later). Further, the

projecting edge of the guide arm 27 is also bent in the shape of U letter in section to provide a slide contact part 29 at its bottom. Then, a difference h in altitude is provided between the bottom surface of the gutter-shaped part 28 of the body spring and the slide contact part 29 of the guide arm 27 such that the slide contact part 29 of the guide arm 27 is located lower than the bottom surface of the gutter-shaped part 28 of the body spring, that is, closer to the surface of the disk 2.

[0054] A description will now be given of the structure of the load ramp with reference to Fig. 3.

[0055] The load ramp 15 is provided as a hard plastic molded product having a mounting part 34, a support part 35 and a rail part 36 in one united body.

[0056] The mounting part 34 has a tapped hole 37, and the load ramp 15 is fixed to the frame plate 12 by fitting a screw into the tapped hole 37, as shown in Fig. 2. The support part 35 and the rail part 36 have a vertically symmetrical shape in cross section, as shown in Figs. 5 to 7.

[0057] As shown in Fig. 5, the support part 35 supports the ends of the arms 17 and 18 (more specifically, each fixed portion 22a at the rear end of the gimbal part 22 in the vicinity of the support spring 21) with the upper and lower surfaces 35a. The elasticity of the elastic bending parts 31 in the center of the body springs 20 permits the upper and lower arms 17 and 18 to put the upper and lower surfaces 35a of the support part 35 therebetween with predetermined force.

[0058] On the other hand, the rail part 36 supports the slide contact part 29 at the end of the guide arm 27 projecting from the body spring 20 sideways with the upper and lower surfaces 36a. That is, in movement of the arms 17 and 18, the slide contact parts 29 of the guide arms 27 slide on the surfaces 36a of the rail part 36.

[0059] The surface 36a of the rail part 36 to support the guide arms 27 is located lower than the surface 35a of the support part 35 to support the upper and lower arms 17 and 18 by a distance equivalent to the difference h in altitude between the bottom surface of the gutter-shaped part 28 of the body spring 20 and the slide contact part 29 of the guide arm 27 (see Fig. 8).

[0060] Further, the support part 36a and the rail part 36 of the load ramp 15 is formed such that their opposite side edges take the shape of a circular arc centering on the axis 23 for axially supporting the head arm 14, when the load ramp 15 is fixed to the frame plate 12 as shown in Fig. 2. The rail part 36 extends longer than the support part 35 into the mounting part 34 inwardly. The length of inward extension of the rail part is approximately equal to the length of the guide arm 27 projecting from the side edge of the body spring 20 sideways.

[0061] As shown in Fig. 5, the upper and lower surfaces of the longitudinal ends (the ends opposite to the mounting part 34) of the support part 36a and the rail part 36 are formed in the shape of taper surfaces 35b, 36b of a thickness reduced gradually toward the ends. Since an angle formed by the upper and lower taper surfaces 35a of the support part 35 is greater than an angle formed by the upper and lower taper surfaces 36b of the rail part 36, a boundary s between the arm support surface 35a and the taper surface 35b of the support part 35 is located more distant from the load ramp mounting part 34 than a boundary r between the guide arm support surface 36a and the taper surface 36b of the rail part 36, as shown in Fig. 5.

[0062] Further, the upper and lower surfaces of the front side end of the support part 35 are formed in the shape of taper surfaces 35c of a thickness reduced gradually toward the front end, as shown in Fig. 8. Thus, each of the surfaces 35a to support the arms 17 and 18 (the gimbal parts 22 thereof in more detail) is cut down into a narrower surface by a portion corresponding to the taper surface 35c (a distance d2 of Fig. 8). As a result, the distance from the ends of the arms 17 and 18 (each engagement hole 25 at the end of the body spring 20 in more detail) to the contact position t on the support surface 35a of the support part 35 to support the arms is expressed by d1 + d2 (If the front side end of the support part 35 has no taper surface 35c, the distance from the end of each of the upper and lower arms 17 and 18 to each arm support surface 35a is expressed by d1.)

[0063] When the head arm 14 is in the retreat position, the upper and lower arms 17 and 18 are located on the support surfaces 35a of the support part 35 in proximity to the mounting part 34, and the guide arms 27 of the upper and lower arms

are located on the guide arm support surfaces 35a of the rail part 36 in proximity to the mounting part 34.

[0064] A description will now be given of the procedure of mounting the load ramp 15 described above to the frame plate 12 with reference to Fig. 2.

[0065] Firstly, the spindle motor 13 is incorporated into the frame plate 12. Secondly, the head arm 14 is mounted to the frame plate 12 such that the frame plate 12 can rotate about the axis 23. The drive coil 24 of the head arm 14 is arranged in a magnetic field of a yoke 40. Further, the load ramp 15 is fixed to the frame plate in a position corresponding to the head arm 14 positioned in the retreat position by fitting a screw 41 into the tapped hole 37 of the mounting part 34. Subsequently, the head 26 fixed to the head arm 14 is connected to the input/output part of the information processor 9 arranged on the surface opposite to the frame plate 12 through a FPC 42.

[0066] Insertion of the cartridge 4 into the magnetic recording device 1 through the insertion opening 33 permits the shutter 5 of the shell 3 to be opened through the motion of the cartridge 4 when inserted. The shell 3 is located on the upper surface of the spindle motor 13, and the disk 2 housed therein is driven with the motor 13. Then, the head arm 14 is pivoted about the axis 23 from the retreat position to the access position for readout or writing of information from or to the disk 2.

[0067] On termination of readout or writing of information from or to the disk 2, the head arm 14 starts movement toward the load ramp 15. Then, the head arm 14 comes to the retreat position, where the upper and lower arms 17 and 18 are put on the support surfaces 35a of the support part 35, and the guide arms 27 are put on the guide arm support surfaces 35a of the rail part 36, and goes into the standby state at the retreat position.

[0068] A description will now be given of the operation from disengagement of the head arm 14 (the upper and lower arms 17 and 18) being in the retreat position from the load ramp 15 till placement of the head arm on the disk 2 with reference to Figs. 5 to 7.

[0069] Fig. 5 shows the state of the head arm 14 being in the retreat position where the head arm is engaged with the load ramp 15. The load ramp 15 is located on the side of the disk 2 (not shown in Fig. 5) at slight distance form the disk 2.

[0070] When the head arm 14 is in the retreat position, the ends of the upper and lower arms 17 and 18 are supported with the support surfaces 35a of the support part 35 of the load ramp 15, and the guide arms 27 projecting from the upper and lower arms 17 and 18 sideways are supported with the support surfaces 36a of the rail part 36. Thus, the distance between the heads 26 mounted closer to the ends of the arms 17 and 18 than the projecting positions of the guide arms 27 is increased.

[0071] Further, the ends of the upper and lower arms 17 and 18 positioned in the retreat position are put on the support surfaces 35a of the support part 35 of the load ramp 15 with the elastic bending parts 31 of the body springs 20 bent. Thus, since the ends of the arms 17 and 18 exert repulsive force to press the support surfaces 35a of the support part 35 of the load ramp 15 with predetermined force at all times, the arms 17 and 18 are placed in the retreat position in a stable state. If harmful vibrations or shocks are applied to the heads 26, it is not feared that the end of each gimbal part is disengaged from the load ramp 15.

[0072] Incidentally, in the upper and lower arms 17 and 18, the portions having the gutter-shaped parts 28 at the opposite sides are hard to be bent structurally, while the portions having the elastic bending parts 31, having no gutter-shaped parts 28 at the opposite sides, are solely subjected to bending when the ends of the upper and lower arms 17 and 18 are engaged with the load ramp 15.

[0073] Incidentally, the gutter-shaped parts 28 may be also used for arrangement of wires serving as lead wires leading to the heads 26.

[0074] The distance d1 + d2 from the ends (the engagement holes 25 of the body springs) of the arms 17 and 18 to the contact positions t on the arm support surfaces 35a of the support part 35 to support the arms is set to be longer. Thus, if vibrations and shocks are applied to the upper and lower arms 17 and 18 positioned in the retreat position, as far as they are within a normal range, such vibrations and shocks can easily

be alleviated in comparison with the case where the above distance is set to be shorter (d1). Accordingly, even if each gimbal part 22 where the head 26 is mounted is deformed to be bent in a direction perpendicular to the surface of the gimbal part, the shocks by deformation can easily be absorbed, and displacement of the gimbal parts 22 by deformation can also be reduced, resulting in that the end of each gimbal part 22 is not disengaged from the engagement hole 25 at the end of the body spring 20.

[0075] Incidentally, the taper surfaces 35c at the front side end of the support part 35 perform the functions of supporting the upper and lower arms 17 and 18 deformed by elasticity in extraordinary intensive vibrations and shocks, resulting in prevention of any further deformation.

[0076] Since the vibrations and shocks applied to the end of the head arm 14 are reduced as described above, application of shocks to the head arm 14 to some extent would cause neither damages to the heads 26 nor disengagement of the end of each gimbal part 22 (the shock-absorbing flat spring material) from the engagement hole at the end of the head arm. As a result, it is possible to offer a card-type magnetic recording device, which is resistant to shocks and permits stable operation.

[0077] When a drive signal is outputted from the information processor 9 to the head arm 14 positioned in the retreat position, the head arm 14 is pivoted about the axis 23 to start movement from the retreat position of Fig. 5 toward the disk access position.

[0078] Then, the upper and lower arms 17 and 18 are moved toward the end of the support part 35 (toward the disk 2) with the ends thereof kept supported with the upper and lower support surfaces 35a of the support part 35 of the load ramp 15. While the upper and lower arms 17 and 18 are sliding on the support surfaces 35a of the support part 35, the heads 26 carried by the upper and lower arms 17 and 18 are hindered by the support part 35 from coming close to each other.

[0079] Fig. 6 shows the state where the upper and lower arms 17 and 18 have moved a little from the position Fig. 5 toward the disk, in which the side edges on the side opposite to the load ramp mounting part 34 have left the support surfaces 35a of the support part 35 of the load ramp 15, while the side edges on the side of the load ramp

mounting part 34 are going to leave the support surfaces 35a. The arms 17 and 18 in this state come up to a space between the disk 2 and the load ramp 15. In this place, the guide arms 27 projecting from the upper and lower arms 17 and 18 sideways (toward the load ramp mounting part 34) are being still supported with the support surfaces 36a of the rail part 36 of the load ramp 15.

[0080] When the arms 17 and 18 are placed in the state shown in Fig. 6, the body spring 20 is subjected to bending at the elastic behind part 31 to permit these arms 17 and 18 to be inclined as shown in Fig. 6.

[0081] Even when the side edges of the arms 17 and 18 (the gutter-shaped parts 28) on the side of the load ramp mounting part 34 begin to leave the support surfaces 35a of the support part 35 of the load ramp 15 in consequence of advancement of the arms further from the position of Fig. 6 toward the disk, the guide arms 27 are still supported with the support surfaces 36a or the taper surfaces 36b of the rail part 36 of the load ramp 15, resulting in no possibility that the arms 17 and 18 may fall in a gap between the load ramp 15 and the disk 2.

[0082] Further, since the guide arms 27 are provided on the arms 17 and 18 at a position at a short distance from the end toward the intermediate portion (or toward the axis 23) in the longitude direction, the distance from the projecting portions of the guide arms 27 to the elastic bending parts 31 in the arms 17 and 18 is shorter than the distance from the contact portions of the arms 17 and 18 with the support part 35 to the elastic bending parts 31. As a result, the guide arms 27 permit the upper and lower arms 17 and 18 whose ends can be opened by upward and downward deformation about the location of the elastic bending parts 31 to be opened at the larger angle, in comparison with the case where the arms are opened by contact of the head arm 14 with the support part 35. Thus, the guide arms 27, provided on the arms 17 and 18 at a position at a short distance from the end toward the intermediate portion, (or toward the axis 23) in the longitude direction, greatly function to maintain the heads 26, 26 on the arm ends at the isolation positions permitting no contact of the heads with the disk 2.

[0083] Further, since the boundary s between the support surface 35a of the support part 35 and the taper surface 35b at the end of the support part 35 is located more distant from the load ramp mounting part 34 than the boundary r between the support surface 36a of the rail part 36 and the taper surface 36b at the end of the rail part 36, the support surfaces 35a of the support part 35 make it possible to maintain the head arm ends higher for a longer period of time. As a result, there is accordingly less possibility that the end of the head arm 14 may fall in the gap between the load ramp 15 and the disk 2.

[0084] With the advancement of the upper and lower arms 17 and 18 further from the position of Fig. 6 toward the disk, the arms 17 and 18 are disengaged fro the load ramp 15. Fig. 7 shows the state, in which the heads 26 mounted to the upper and lower arms 17 and 18 gain access to the opposite surfaces of the disk 2 in consequence of the advancement of the arms 17 and 18 toward the disk.

[0085] As described above, when the ends of the upper and lower arms 17 and 18 slide on the support surfaces 35a of the support part 35 of the load ramp 15 toward the disk 2, or the upper and lower arms 17 and 18 positioned in the disk access position slide on the support surfaces 35a of the support part 35 from the disk toward the retreat position, the guide arms integral with the upper and lower arms 17 and 18 function as a guide for movement of the arms 17 and 18 by sliding on the support surfaces 36a of the rail part 36 of the load ramp 15.

[0086] On termination of readout or writing of information from or to the opposite surfaces of the disk 2 by the heads 26 of the upper and lower arms 17 and 18 in an access position, excitation of the drive coil 24 is released to return the arms 17 and 18 to the retreat position by the action of the return spring. In this place, the guide arms 27 of the upper and lower arms 17 and 18 firstly come into contact with the load ramp 15, and the slide contact parts 29 slide upward on the taper surfaces 36b at the end of the rail part 36.

[0087] As shown in Fig. 5, since the inclination angle of each taper surface 36b is relatively more gentle than that of each taper surface 35b of the support part 35, the

guide arms 27 may slide upward smoothly on the taper surfaces 36b. Then, the ends of the upper and lower arms 17 and 18 are slightly opened with the increasing distance (thickness) between the upper and lower taper surfaces 36b, and in this state, the side edges (the gutter-shaped parts 28) of the upper and lower arms 17 and 18 on the side opposite to the disk make contact with the taper surfaces 35b of the support part 35.

[0088] Since the guide arms 27 are of small width and are located close to the axis 23 about which the guide arms 27 rotate so that the force of the return spring is made strong, the slide contact parts 29 at the ends of the guide arms 27 can easily to ride onto the taper surfaces 36b of the rail part 36.

[0089] Further, when the gutter-shaped parts 28 in the side edges of the arms 17 and 18 which are moving toward the retreat position, on the side of the load ramp mounting part 34, make contact with the taper surfaces 35b of the support part 35, the ends of the upper and lower arms 17 and 18 are placed in the slightly opened state as described above and therefore, the subsequent riding of the gutter-shaped parts 28 of the upper and lower arms 17 and 18 onto the taper surfaces 35b of the support part 35 becomes easy.

[0090] As a result, the upper and lower arms 17 and 18 may be guided to the upper and lower support surfaces 35a of the support part 35 of the load ramp 15 smoothly, respectively, so that they are positioned in a retreat position stably.

[0091] The above description has been given of one embodiment, in which the guide means for guiding the end of the head arm 14 is composed of the part on the side of the head arm 14 and the part on the side of the load ramp 15. However, the guide means may be composed of a guide arm on the side of the head arm 14 and a cam surface provided on the side of the frame plate 12, with which the guide arm makes contact, or may composed of a part on the side of the head arm 14.

CLAIMS

1. A card-type magnetic recording device comprising:

a head arm which carries a magnetic recording/reproducing head carried;

a motor for driving to revolve a disk which serves as a recording medium for recording of information;

a load ramp permitting to place said head on standby after retreat of the head from the surface area of the disk; and

an information processor:

wherein said head arm is formed in the shape of a flat plate and adopts a swing arm structure permitting swing motions about an axis in the base part; and

said load ramp is arranged at a distance from the peripheral edge of the disk.

2. A card-type magnetic recording device according to claim 1, further comprising guide means for guiding the end of said head arm from said load ramp toward the surface area of the disk and also in the reverse direction.

3. A card-type magnetic recording device according to claim 2, wherein said guide means is provided on said head arm.

4. A card-type magnetic recording device according to claim 2, wherein said guide means is composed of a structure provided on the head arm and a structure provided on the side of the load ramp.

5. A card-type magnetic recording device comprising:

a head arm of swing arm structure, which carries a magnetic recording/reproducing head;

a motor for revolving a disk serving as a recording medium for recording/reproduction of information;

a load ramp permitting to place said head on standby after retreat of the head from

the surface area of the disk;

an information processor; and

a guide arm provided on the head arm at a position at a distance from the end toward the intermediate position in the longitudinal direction in a manner such that it projects toward the side opposite to the disk;

wherein the projection end of said guide arm remains on the load ramp when the end of the head arm, which moves toward the disk, is disengaged from the load ramp, thus maintaining the head arm end at an isolation position where the head does not make contact with the disk within the disk surface area, during the time until the guide arm is disengaged from the load ramp.

6. A card-type magnetic recording device according to claim 5, wherein said load ramp has a support part for supporting the end of the head arm and a rail part for supporting the end of the guide arm, and each of the ends of the support part and the rail part on the side of the disk is formed in the shape of a taper surface of a thickness gradually reduced toward the disk.

7. A card-type magnetic recording device according to claim 6, wherein the surface, which serves as the head arm end, of the support part is inclined toward the base part of the head arm to bring a contact portion of the head arm end with the support part closer to the base part of the head arm.

8. A card-type magnetic recording device according to claim 6, wherein the taper surface in said support part begins at position closer to the disk side than the taper surface of the rail part.

9. A card-type magnetic recording device according to claims 6 or 8, wherein the projection end of the guide arm is located closer to the inner side of the head arm than the end of the head arm while maintaining a difference in altitude, and the rail part and

the support part are formed to maintain the same difference in altitude as the above difference.

10. A card-type magnetic recording device according to claim 5, wherein a part of the opposite edges of the head arm in a longitudinal direction are bent in the shape of letter U in section, and a lead wire is housed in the bent portion.

11. A card-type magnetic recording device according to claim 5, wherein the head arm has a support spring whose end is formed in the shape of a gimbal part, the head is carried on the gimbal part, and the end of the gimbal part is engaged with an engagement hole formed at the end of the head arm.